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(71)Applicant : TOYOTA MOTOR CORP

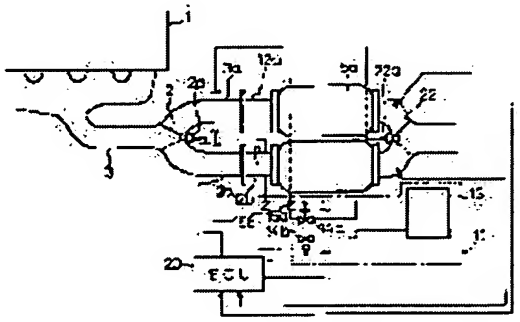
(72)Inventor : HARADA YASUO
ARAKI YASUSHI
HIROTA SHINYA
OBATA KIYOSHI

(54) EXHAUST GAS PURIFIER OF INTERNAL COMBUSTION ENGINE

(57)Abstract:

PURPOSE: To prevent drop of temperature during a standby period after regeneration of NOx absorbent is completed and maintain suction capability at a high level when suction of NOx is resumed.

CONSTITUTION: NOX absorbent 5a is connected in parallel in an exhaust air passage 3 of an internal combustion engine 1 to carry out regeneration of the NOx absorbent 5a alternately by changing over exhaust air alternately by exhaust air change-over valves 2, 22. An engine control circuit(ECU) 20 changes over the exhaust air change-over valves 2, 22 to reduce the flow rate of exhaust air which flows into the NOX absorbent and supply reduction agent to the NOX absorbent on the side where the flow rate of exhaust air is reduced from a reduction agent supply device 11 so as to regenerate the NOX absorbent. After regeneration is completed, supply of reduction agent is continued so that air-fuel ratio of exhaust air which passes the NOX absorbent in the standby condition approaches a theoretical air-fuel rati. Consequently, it is possible to prevent drop of temperature of the NOX absorbent because oxidation reaction of the reduction agent occurs on the NOX absorbent even the standby condition.



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CLAIMS

[Claim(s)]
[Claim 1] NOX under exhaust air to the flueway of the internal combustion engine which can burn the Lean air-fuel ratio when the air-fuel ratio of inflow exhaust air is Lean It absorbs. NOX absorbed when a reducing agent was supplied during inflow exhaust air and an oxygen density fell NOX to emit An absorbent is arranged. NOX It is NOX after making it absorb. It is NOX while reducing the exhaust air flow rate which flows into an absorbent. NOX which supplied and absorbed the reducing agent to the absorbent Playback actuation made to emit, An exhaust air flow rate is recovered after playback termination, and it is NOX. In the exhaust emission control device of the internal combustion engine which repeats the actuation which resumes absorption An exhaust air flow rate is recovered and it is said NOX. Predetermined period NOX before resuming absorption A reducing agent is supplied to an absorbent and it is NOX. Exhaust emission control device of the internal combustion engine characterized by establishing a means to control the exhaust air air-fuel ratio which passes an absorbent near the theoretical air fuel ratio.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is NOX under exhaust air of internal combustion engines which perform combustion of the Lean air-fuel ratio, such as a gasoline engine which carries out a diesel power plant and lean combustion to a detail, about an internal combustion engine's exhaust emission control device. It is effectively related with a removable exhaust emission control device.
[0002]
[Description of the Prior Art] As an example of this kind of exhaust emission control device, there are some which were indicated by the Provisional-Publication-No. 62-No. 106826 official report, for example. The equipment of this official report is NOX under existence of oxygen to a Diesel engine's flueway. The absorbent (catalyst) to absorb is arranged and it is NOX under exhaust air. It is made to absorb. NOX of this absorbent When absorptance is saturated, the inflow of the exhaust air to an absorbent is intercepted and a reducing agent is supplied to an absorbent, and it is NOX. NOX emitted while making NOX emit from an absorbent by making an absorbent into the ambient atmosphere under a rich air-fuel ratio It is made to carry out reduction purification.
[0003]
[Problem(s) to be Solved by the Invention] With the exhaust emission control device of the above-mentioned Provisional-Publication-No. 62-No. 106826 official report, it is NOX. The inflow of the exhaust air to an absorbent is intercepted and it is NOX. By supplying a reducing agent to an absorbent, it is NOX. Playback actuation of an absorbent is performed (NOX of the above in this specification in addition NOX from an absorbent actuation of emission and reduction purification is called "playback actuation of a NOX absorbent"). However, with the equipment of the above-mentioned official report, it is NOX of after playback actuation termination and a degree. Standby term period NOX to resumption of absorption actuation If it holds in the condition [having intercepted the inflow of exhaust air of an absorbent], since hot exhaust air will not be supplied, it is NOX to throughout [standby term]. The temperature of an absorbent may fall. NOX of plurality [flueway] especially an absorbent -- juxtaposition -- connecting -- the inflow of exhaust air in sequence -- intercepting -- NOX a case so that an absorbent may be reproduced -- every -- NOX NOX of an absorbent in order to make the most of absorptance -- NOX The time amount which absorbs is sharply set up for a long time from time amount required for playback. For this reason, the waiting period after playback actuation termination becomes long, and it is NOX. The temperature fall of an absorbent also becomes large.
[0004] NOX NOX of an absorbent Absorptance is NOX to throughout [standby term] as mentioned above, in order to fall sharply in a low-temperature region. It is NOX if the temperature of an absorbent falls. It is NOX when absorption is resumed. An absorbent cannot demonstrate predetermined absorptance but it is NOX under exhaust air. The problem to which purification effectiveness falls arises. in order to solve this -- NOX after playback termination of an absorbent -- immediately -- NOX absorption actuation -- starting -- NOX of a standby term throughout although it is also possible to prevent the temperature fall of an absorbent -- NOX of plurality as mentioned above if it shortens the change period of absorption and playback in connecting, switching and using an absorbent for juxtaposition in a flueway -- every -- NOX NOX of an absorbent There is a problem it becomes impossible to utilize absorptance effectively. Moreover, NOX It is not desirable for effect

to arise in an engine output by fluctuation of the exhaust back pressure accompanying the exhaust air inflow cutoff to an absorbent, and to shorten a change period.
[0005] This invention takes an example above and is NOX of the standby term throughout after playback actuation termination. The temperature fall of an absorbent is prevented and it is NOX. NOX at the time of resumption of absorption actuation It aims at offering the exhaust emission control device of the internal combustion engine which can maintain the absorptance of an absorbent highly.
[0006]
[Means for Solving the Problem] According to this invention, to the flueway of the internal combustion engine which can burn the Lean air-fuel ratio NOX under exhaust air when the air-fuel ratio of inflow exhaust air is Lean NOX which was absorbed, and was absorbed when a reducing agent was supplied during inflow exhaust air and an oxygen density fell NOX to emit An absorbent is arranged. NOX It is NOX after making it absorb. It is NOX while reducing the exhaust air flow rate which flows into an absorbent. NOX which supplied and absorbed the reducing agent to the absorbent Playback actuation made to emit, An exhaust air flow rate is recovered after playback termination, and it is NOX. In the exhaust emission control device of the internal combustion engine which repeats the actuation which resumes absorption An exhaust air flow rate is recovered and it is said NOX. Predetermined period NOX before resuming absorption A reducing agent is supplied to an absorbent and it is NOX. The exhaust emission control device of the internal combustion engine characterized by establishing a means to control the exhaust air air-fuel ratio which passes an absorbent near the theoretical air fuel ratio is offered.
[0007]
[Function] NOX Before resumption of absorption, it is NOX. The gaseous mixture of the exhaust air and the reducing agent of the air-fuel ratio near the theoretical air fuel ratio is supplied to an absorbent, and it is NOX. The oxidation heat of reaction of a reducing agent arises on an absorbent. Thereby, it is NOX of a standby term throughout. The temperature of an absorbent is maintained highly and it is NOX. NOX at the time of resumption of absorption The absorptance fall of an absorbent does not arise.
[0008]
[Example] Hereafter, the example of this invention is explained using an accompanying drawing. In drawing 1 , the internal combustion engine with which 1 can burn the Lean air-fuel ratios, such as a diesel power plant and a gasoline engine which performs lean combustion, and 3 show an internal combustion engine's 1 flueway <TXF FR=0001 HE=250 WI=080 LX=0200 LY=0300>. NOX under exhaust air when the exhaust air air-fuel ratio which two branching paths 3a and 3b are established in the flueway 3 in this example, and flows into Paths 3a and 3b, respectively is Lean NOX which was absorbed, and was absorbed when the oxygen density under exhaust air fell NOX to emit Each of absorbents 5a and 5b are connected.
[0009] Moreover, the exhaust air diverter valve 2 is formed in the tee of the paths 3a and 3b of a flueway 3, one side of the arbitration of Flueways 3a and 3b is closed to predetermined opening, and exhaust air is distributed to Flueways 3a and 3b. For example, if the exhaust air change-over valve 2 is switched to the location shown in drawing 1 as the continuous line, the exhaust air flow rate which the great portion of exhaust air flows into the branching path 3b side, and flows into the branching path 3a side will be reduced. Moreover, if the exhaust air change-over valve 2 is switched to the location shown in drawing 1 by the dotted line, the exhaust air flow rate which the great portion of exhaust air flows into the branching path 3a side, and flows into the branching path 3b side will be reduced. It is the actuator of proper formats, such as a negative pressure actuator for driving a diverter valve 2 with the control signal from the engine control circuit (ECU) 20 mentioned later, and making it take a predetermined switch location, which is shown in drawing by 2a.
[0010] Moreover, at this example, the branching paths 3a and 3b are NOX. It joins again by absorbent 5a and 5b downstream, and the exhaust air change-over valve 2, the same exhaust air change-over valve 22, and actuator 22a are prepared in this unification section. The exhaust air change-over valve 22 is the below-mentioned NOX while controlling the exhaust air flow rate which is interlocked with the exhaust air change-over valve 2, operates, and flows into each branching path. NOX under playback at the time of absorbent playback actuation It has prevented that exhaust air

flows backwards from the downstream to an absorbent.
[0011] Furthermore, NOX of the branching paths 3a and 3b The reducing-agent feeder 11 later mentioned to absorbent 5a and 5b upstream to NOX Each of reducing-agent supply nozzles 12a and 12b which supply a reducing agent are connected to Absorbents 5a and 5b. Moreover, it is NOX of the branching paths 3a and 3b which 7a and 7b show to drawing 1 , respectively. It is the air-fuel ratio sensor arranged at absorbent 5a and 5b downstream. The air-fuel ratio sensors 7a and 7b detect the oxygen density under exhaust air, and the so-called all-over-the-districts air-fuel ratio sensor which generates the output voltage corresponding to an exhaust air air-fuel ratio in the large range is used.
[0012] It is the control circuit (ECU) of an engine 1 which is shown in drawing by 20. ECU20 consists of a well-known digital computer of a configuration of having connected CPU, RAM, ROM and input port, and an output port mutually with the bi-directional bus, and is performing basic control, such as fuel-oil-consumption control of an engine. Moreover, in this example, ECU20 drives Actuators 2a and 22a further through a drive circuit, a negative pressure-limiting valve, etc. which are not illustrated, and performs switch position control of the exhaust air diverter valves 2 and 22, and also it is performing reducing-agent supply control from the reducing-agent feeder 11. For these control, the air-fuel ratio signal from the air-fuel ratio sensors 7a and 7b is inputted, and also signals, such as an engine speed and an engine inhalation air content, are inputted into the input port of ECU20 from the sensor which is not illustrated, respectively.
[0013] The reducing-agent feeder 11 is equipped with the control valves 14a and 14b which adjust the flow rate of the reducing-agent amount of supply supplied to the reducing-agent supply nozzles 12a and 12b from the reducing-agent source of supply 13 which consists of a reducing-agent container, a booster pump, etc., and the reducing-agent source of supply 13, and the check valves 15a and 15b for exhaust air antisuckbacks arranged between Nozzles 12a and 12b and control valves 14a and 14b. Control valves 14a and 14b are NOX mentioned later. It is NOX about the reducing agent of an amount according to the control signal of ECU20, take predetermined opening throughout [time of playback actuation of Absorbentsa / 5 / and 5b, and standby term / of after that], and corresponding to opening. Absorbents 5a and 5b are supplied.
[0014] NOX NOX of Absorbents 5a and 5b Liquid fuel, such as a hydrocarbon of liquids, such as gases, such as hydrogen and a carbon monoxide, a propane, a propylene, and butane, or a gas, a gasoline, gas oil, and kerosene, etc. can be used that what is necessary is just what is exhausting and generates reduction components, such as a hydrocarbon and a carbon monoxide, as a reducing agent used for emission and reduction actuation (playback actuation). NOX Absorbents 5a and 5b use support, such as an alumina, and are Potassium K, Sodium Na, Lithium Li, and Caesium Cs on this support. Alkali metal [like] and barium Ba, Calcium calcium At least one chosen from an alkaline earth [like], Lanthanum La, and rare earth like Yttrium Y, and platinum Pt Noble metals [like] are supported. This NOX Absorbents 5a and 5b are NOX when the air-fuel ratio of the flowing exhaust air is Lean. It is NOX, if it absorbs and an oxygen density falls. NOX to emit An absorption/emission action is performed.
[0015] In addition, an above-mentioned exhaust air air-fuel ratio is NOX here. The ratio of the sum total of an air content, the fuel, and the sum total of a reducing agent which were supplied to the flueway of the upstream of Absorbents 5a and 5b, an engine combustion chamber, an inhalation-of-air path, etc., respectively shall be meant. Therefore, NOX When a fuel, a reducing agent, or air is not supplied to the upstream flueway of Absorbents 5a and 5b, an exhaust air air-fuel ratio becomes equal to an engine operation air-fuel ratio (air-fuel ratio in combustion of an engine combustion chamber).
[0016] Since the engine which burns the Lean air-fuel ratio is used in this example, the exhaust air air-fuel ratio at the time of operation is usually Lean, and it is NOX. Absorbents 5a and 5b are NOX under exhaust air. It absorbs. Moreover, it is NOX, if a reducing agent is introduced during exhaust air from the reducing-agent feeder 11 and an oxygen density falls. Absorbents 5a and 5b emit the absorbed reducing agent. There is also a part which is not clear about the detailed mechanism of this absorption/emission action. However, it is thought that this absorption/emission action is performed by the mechanism as shown in drawing 2 . Next, it is Platinum Pt on support about this mechanism. And barium Ba It becomes the same mechanism even if it uses other noble metals, alkali metal, an

alkaline earth, and rare earth, although explained taking the case of the case where it is made to support.

[0017] That is, if inflow exhaust air becomes Lean considerably, the oxygen density under inflow exhaust air will increase sharply, and it is drawing 2 (A). It is these oxygen O2 so that it may be shown. O2 - Or O2 - It is Platinum Pt in a form. It adheres to a front face. on the other hand -- NO under inflow exhaust air -- platinum Pt a front-face top -- this O2- or O2- reacting -- NO2 It becomes (2 NO+O2 ->2NO2). Subsequently, generated NO2 A part is drawing 2 (A), being absorbed in an absorbent and combining with the barium oxide BaO oxidizing on Platinum Pt. It is nitrate ion NO3 so that it may be shown. - It is spread in an absorbent in a form. Thus, NOX NOX It is absorbed in absorbent 5a and 5b.

[0018] Therefore, it is Platinum Pt as long as the oxygen density under inflow exhaust air is high. It is NO2 in a front face. It is generated and is NOX of an absorbent. It is NO2 unless absorptance is saturated. It is absorbed in an absorbent and is nitrate ion NO3. - It is generated. On the other hand, the oxygen density under inflow exhaust air falls, and it is NO2. When the amount of generation decreases, a reaction goes to hard flow (NO3-->NO2), and it is the nitrate ion NO3 in an absorbent in this way. - NO2 It is emitted from an absorbent in a form. That is, it is NOX if the oxygen density under inflow exhaust air falls. Absorbents 5a and 5b to NOX It will be emitted.

[0019] On the other hand, these components are Platinum Pt if reduction components, such as HC and CO, exist during inflow exhaust air. Upper oxygen O2 - Or it reacts with O2-, and oxidizes, the oxygen under exhaust air is consumed, and the oxygen density under exhaust air is reduced. Moreover, it is NOX by the oxygen density fall under exhaust air. NO2 emitted from Absorbents 5a and 5b Drawing 2 (B) It reacts with HC and CO and is returned so that it may be shown. Thus, platinum Pt It is NO2 on a front face. When it stops existing, it is NO2 from an absorbent to the degree from a degree. It is emitted.

[0020] namely, HC under inflow exhaust air and CO -- first -- platinum Pt Upper O2- or it reacts immediately with O2- and oxidizes -- having -- subsequently -- platinum Pt Upper O2- Or NOX emitted by this HC and CO from the absorbent when HC and CO still remained, even if O2- was consumed and NOX which flows with exhaust air It is returned. At this example, it is NOX by actuation of the exhaust air change-over valves 2 and 22. NOX of Absorbents 5a and 5b Absorption and emission are performed by turns. That is, at this example, it is one NOX by actuation of the exhaust air change-over valves 2 and 22. A great portion of exhaust air is passed to an absorbent (for example, 5a), and it is NOX. It is made to absorb. Moreover, NOX NOX of absorbent 5a If an absorbed amount increases, the exhaust air change-over valves 2 and 22 are switched, and it is NOX of another side. They are a sink and NOX about exhaust air to absorbent 5b. While reducing the exhaust air flow rate which flows into absorbent 5a, it is reducing-agent supply nozzle 12a to NOX. A reducing agent is supplied to absorbent 5a, and it is NOX. Absorbent 5a is reproduced. Moreover, after [NOX] a change NOX of absorbent 5b If an absorbed amount increases, the exhaust air change-over valves 2 and 22 are switched again, and it is NOX. Exhaust air is passed to the absorbent 5a side, and it is NOX. NOX by absorbent 5a It is NOX while resuming absorption. Absorbent 5b is reproduced.

[0021] Above NOX An absorbent is NOX. The time amount which can absorb is NOX to about 10 minutes and a comparatively long thing. Time amount required for playback of an absorbent is comparatively as short as about dozens of seconds. Therefore, NOX which playback actuation ended Next an exhaust air change-over valve is switched, and an absorbent is NOX. It will be put on a standby condition, with an exhaust air flow rate reduced until it resumes absorption. For this reason, it is NOX to throughout [standby term]. The problem to which the temperature of an absorbent falls arises.

[0022] NOX waiting in the example by this invention A reducing agent is supplied to an absorbent and it is NOX. By maintaining the air-fuel ratio of the exhaust air which passes an absorbent near the theoretical air fuel ratio, it is NOX. The problem of a temperature fall of an absorbent is solved. Namely, NOX The absorbent has the function as an oxidation catalyst which promotes oxidation of reduction components, such as HC and CO, under existence of oxygen, as drawing 2 explained. Therefore, waiting NOX By supplying oxygen and a reducing agent to an absorbent, it is NOX. Oxidation reaction of a reducing agent is produced on an absorbent, and it is NOX by heat of

reaction. It becomes possible to prevent the temperature fall of an absorbent. It is waiting NOX about the gaseous mixture of the exhaust air and the reducing agent which were maintained in the example by this invention near [optimal] the theoretical air fuel ratio for the above-mentioned oxidation reaction. By supplying an absorbent, it is NOX. The temperature of an absorbent is held highly and it is NOX. The fall of the absorptance at the time of resumption of absorption is prevented.
[0023] Next, exhaust air purification actuation of this example is explained. By the following explanation, it is NOX of drawing 1 . NOX of absorbent 5a It is NOX although absorption and playback actuation are explained. Absorption and playback actuation are completely similarly performed about absorbent 5b. The exhaust air change-over valves 2 and 22 are held in the location of the dotted line of drawing 1 , and it is NOX. It is NOX if the great portion of exhaust air of an engine flows into absorbent 5a. Absorbent 5a is NOX under exhaust air as mentioned above. It absorbs. Subsequently, predetermined time passes and it is NOX. NOX of absorbent 5a If an absorbed amount increases, ECU20 will switch the exhaust air change-over valves 2 and 22 to the location of the continuous line of drawing 1 , and it is NOX. Playback actuation of absorbent 5a is started.
[0024] In addition, at this example, it is NOX. It is an engine's NOX although playback of an absorbent is performed for every fixed time amount. It responds to an yield and is NOX. NOX of an absorbent It is NOX whenever an absorbed amount reaches a predetermined value. It may be made to reproduce an absorbent. In this case, ECU20 is NOX per an engine's unit time amount. The yield is beforehand stored in ROM as a function of an engine load (for example, inhalation air content per engine 1 rotation), and an engine rotational frequency, engine load conditions are read for every predetermined time, and it is above NOX from ROM. An yield is read, what multiplied this yield by the fixed multiplier is integrated, and it is NOX. NOX of an absorbent It considers as an absorbed amount. This NOX It is NOX when an absorbed amount reaches a predetermined value. He will be Engine NOX if it is made to reproduce an absorbent. Irrespective of change of an yield, it is NOX. NOX of an absorbent Absorptance is effectively utilizable.
[0025] It is NOX if the exhaust air change-over valves 2 and 22 are switched to the location of the continuous line of drawing 1 . The exhaust air flow rate which flows into absorbent 5a falls, and the great portion of exhaust air is NOX. It is NOX, in order to pass absorbent 5b and to flow. NOX under exhaust air by absorbent 5b Absorption is performed. NOX Playback actuation of absorbent 5a is performed by the following procedures. First, ECU20 is NOX. NOX which started absorption NOX which reads an engine's exhaust air air-fuel ratio in the output of air-fuel ratio sensor 7b arranged at the downstream of absorbent 5b, and is reproduced with this exhaust air air-fuel ratio The exhaust air flow rate which flows into the absorbent 5a side to NOX The reducing-agent flow rate which should be supplied to absorbent 5a is determined. At this example, it is NOX at the time of playback actuation. The reducing-agent flow rate supplied to an absorbent is NOX. It considers as the amount to which only the specified quantity maintains the exhaust air air-fuel ratio which flows into an absorbent from theoretical air fuel ratio to a rich side. Moreover, an exhaust air change-over valve is passed at the time of playback actuation, and it is NOX. As a function of service conditions, such as an engine load and a rotational frequency, the exhaust air flow rate which flows into an absorbent is beforehand calculated by observation etc., and is stored in ROM.
[0026] ECU20 sets the control valve 14 of the reducing-agent feeder 11 as the opening corresponding to the reducing-agent flow rate computed by the above, and is NOX. It is NOX while supplying a reducing agent to absorbent 5a. The supply time amount of a reducing agent is controlled based on the output of air-fuel ratio sensor 7a of the absorbent 5a downstream. As mentioned above, NOX If the reducing-agent supply to an absorbent is started, a reducing agent is under exhaust air and NOX first. O2 on the front face of Pt of an absorbent It consumes and is this O2. It is NOX after consuming. Reduction purification is started. Therefore, in the phase in early stages of after reducing-agent supply initiation, it is NOX. The oxygen density under exhaust air which flows out of an absorbent is comparatively high, and is the above O2. It is consumed and is NOX. If reduction starts, the oxygen density under exhaust air will fall rapidly. After detecting the fall of the above-mentioned oxygen density from output change of air-fuel ratio sensor 7a, ECU20 maintains said reducing-agent amount of supply during a predetermined period so that an exhaust air air-fuel ratio may become rich. Thereby, it is NOX. A reducing agent superfluous after absorbent

playback termination is NOX. Flowing out of an absorbent is prevented. In addition, this period is NOX. NOX absorbed to the absorbent According to the amount (absorption time amount), it is set up beforehand.

[0027] After the above-mentioned playback actuation termination and NOX Absorbent 5a is next NOX, with the flow rate of exhaust air reduced. In preparation for absorption initiation, it is put on a standby condition. At this example, ECU20 is waiting NOX after the above-mentioned playback time amount passes. Based on the output of air-fuel ratio sensor 7a, feedback control of the opening of control valve 14a is carried out so that the exhaust air air-fuel ratio of the absorbent 5a downstream may become near the theoretical air fuel ratio. Thus, it is waiting NOX by carrying out feedback control of the reducing-agent amount of supply based on the air-fuel ratio sensor output of the downstream. Since it is correctly held near the theoretical air fuel ratio, the exhaust air air-fuel ratio which passes an absorbent is NOX. Good oxidation reaction of the reducing agent supplied to the absorbent is obtained, and it is waiting NOX. Absorbent temperature is highly maintainable. Moreover, thereby, it is NOX. Since the whole quantity of the reducing agent supplied to the absorbent can be oxidized, a superfluous reducing agent is NOX. Flowing into an absorbent lower stream of a river is prevented.

[0028] Drawing 3 is NOX by the above-mentioned actuation. The change cycle of the exhaust air air-fuel ratio which flows into an absorbent is shown. It sets to drawing 3 and is NOX. NOX of an absorbent At the time of absorption actuation, it is NOX. The exhaust air air-fuel ratio which flows into an absorbent is maintained by the Lean air-fuel ratio (drawing 3 and section I). Subsequently, it is NOX if the change of an exhaust air change-over valve is performed. A reducing agent is supplied to an absorbent, the predetermined period exhaust air air-fuel ratio after a change is held at a rich air-fuel ratio, and it is NOX. Playback of an absorbent is performed (drawing 3 , section II). Moreover, NOX For an exhaust air air-fuel ratio, it is maintained near the theoretical air fuel ratio, and throughout [standby term / after playback of an absorbent is completed] is NOX. The temperature of an absorbent is maintained highly (drawing 3 , section III). It is NOX if the change of an exhaust air change-over valve is again performed in this condition. The air-fuel ratio of the exhaust air which flows into an absorbent turns into the Lean air-fuel ratio again, and is NOX. An absorbent is NOX, without temperature falling. Absorption is resumed (drawing 3 , section IV).

[0029] In addition, at an above-mentioned example, it is NOX. After completing playback actuation of an absorbent, it is NOX succeedingly. Although the exhaust air air-fuel ratio which flows into an absorbent is maintained to theoretical air fuel ratio When a waiting period is especially long, supply of a reducing agent is once suspended after playback actuation termination, and it is NOX. By only the predetermined period's before resuming absorption supplying a reducing agent, and maintaining an exhaust air air-fuel ratio to theoretical air fuel ratio, it is NOX. It is NOX before resumption of absorption. You may make it raise absorbent temperature.

[0030] Moreover, at this example, it is waiting NOX only by control of the amount of supply of a reducing agent. Although the exhaust air air-fuel ratio which flows into an absorbent is adjusted, it is also possible to control an exhaust air air-fuel ratio by adjusting the displacement which controls the opening of the exhaust air change-over valves 2 and 22, and flows with the reducing-agent amount of supply.

[0031]

[Effect of the Invention] The exhaust emission control device of this invention is NOX as mentioned above. Waiting NOX before resumption of absorption By having supplied the gaseous mixture of the exhaust air and the reducing agent near the theoretical air fuel ratio to the absorbent, it is waiting NOX. The temperature fall of an absorbent is prevented effectively and it is NOX. NOX at the time of absorption initiation The effectiveness it is ineffective to it being possible to maintain the absorptance of an absorbent highly is done so.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the general drawing showing one example of the exhaust emission control device of this invention.
[Drawing 2] NOX NOX of an absorbent It is drawing explaining an absorption/emission action.
[Drawing 3] NOX It is drawing explaining the change cycle of the exhaust air air-fuel ratio which flows into an absorbent.
[Description of Notations]
1 -- Internal combustion engine
3 -- Flueway
3a, 3b -- Branching path
5a and 5 b--NOX Absorbent
2 22 -- Exhaust air diverter valve
11 -- Reducing-agent feeder (whole)

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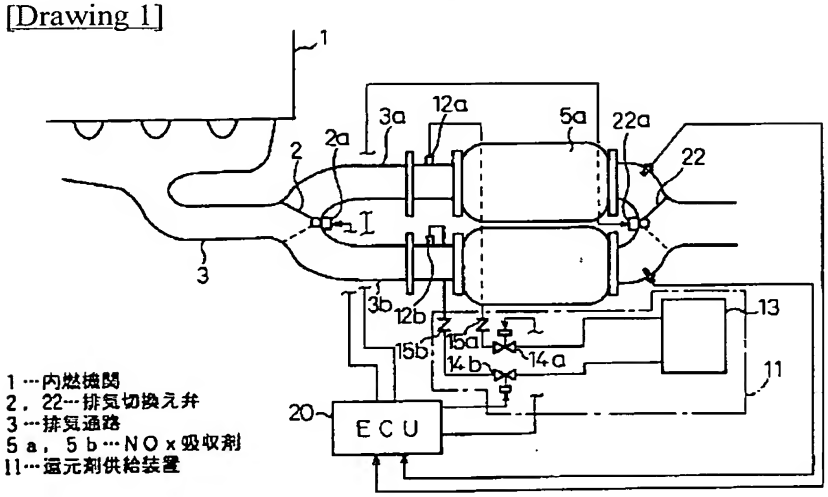
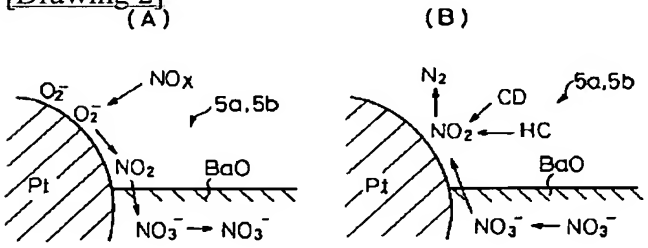
DRAWINGS

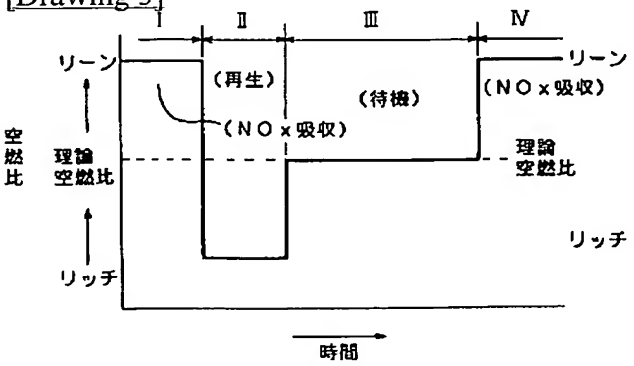
[Drawing 1]



[Drawing 2]



[Drawing 3]



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(71) Applicant: TOYOTA MOTOR CORP

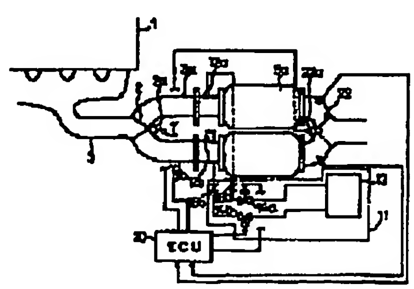
(72) Inventor: HARADA YASUO
ARAKI YASUSHI
HIROTA SHINYA
OBATA KIYOSHI

(54) EXHAUST GAS PURIFIER OF INTERNAL COMBUSTION ENGINE

(57) Abstract:

PURPOSE: To prevent drop of temperature during a standby period after regeneration of NOx absorbent is completed and maintain suction capability at a high level when suction of NOx is resumed.

CONSTITUTION: NOX absorbent 5a is connected in parallel in an exhaust air passage 3 of an internal combustion engine 1 to carry out regeneration of the NOx absorbent 5a alternately by changing over exhaust air alternately by exhaust air change-over valves 2, 22. An engine control circuit(ECU) 20 changes over the exhaust air change-over valves 2, 22 to reduce the flow rate of exhaust air which flows into the NOX absorbent and supply reduction agent to the NOX absorbent on the side where the flow rate of exhaust air is reduced from a reduction agent supply device 11 so as to regenerate the NOX absorbent. After regeneration is completed, supply of reduction agent is continued so that air-fuel ratio of exhaust air which passes the NOX absorbent in the standby condition approaches a theoretical air-fuel rati. Consequently, it is possible to prevent drop of temperature of the NOX absorbent because oxidation reaction of the reduction agent occurs on the NOX absorbent even the standby condition.



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(71)出願人　000003207
トヨタ自動車株式会社
愛知県豊田市トヨタ町１番地

(72)発明者　原田　泰生
愛知県豊田市トヨタ町１番地　トヨタ自動車株式会社内

(72)発明者　荒木　康
愛知県豊田市トヨタ町１番地　トヨタ自動車株式会社内

(72)発明者　広田　信也
愛知県豊田市トヨタ町１番地　トヨタ自動車株式会社内

(74)代理人　弁理士　宇井　正一　（外４名）

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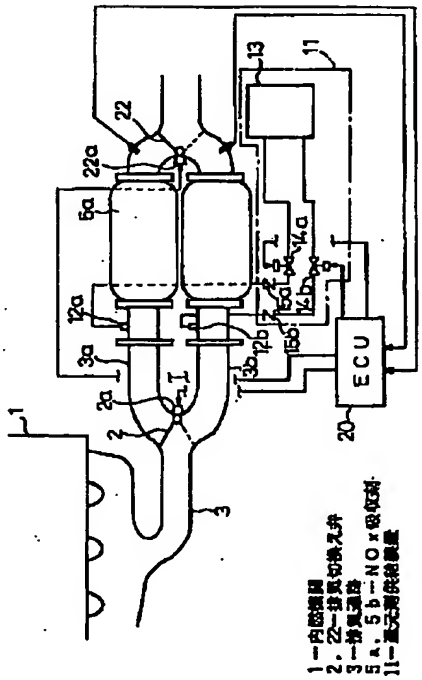
(54)【発明の名称】　内燃機関の排気浄化装置

(57)【要約】

【目的】　NO_x 吸収剤の再生終了後の待機期間中の温度低下を防止し、NO_x吸収再開時の吸収能力を高く維持する。

【構成】　内燃機関１の排気通路３にNO_x 吸収剤５ａ、５ｂを並列に接続し、排気切換え弁２、２２により排気を交互に切り換えてNO_x 吸収剤５ａ、５ｂの再生を交互に行う。エンジン制御回路（ＥＣＵ）２０は、排気切換え弁２、２２を切り換えてNO_x 吸収剤に流入する排気流量を低減するとともに、還元剤供給装置１１から排気流量を低減した側のNO_x 吸収剤に還元剤を供給しNO_x 吸収剤の再生を行い、再生終了後は、待機中のNO_x 吸収剤を通過する排気空燃比が理論空燃比近傍になるように還元剤の供給を継続する。待機中もNO_x 吸収剤上で還元剤の酸化反応が生じるため、NO_x 吸収剤の温度低下が防止される。



【特許請求の範囲】

【請求項1】　リーン空燃比の燃焼を行うことのできる内燃機関の排気通路に、流入排気の空燃比がリーンのときに排気中のNO_xを吸収し、流入排気中に還元剤が供給され酸素濃度が低下したときに吸収したNO_xを放出するNO_x吸収剤を配置し、NO_xを吸収させた後にNO_x吸収剤に流入する排気流量を低減するとともにNO_x吸収剤に還元剤を供給して吸収したNO_xを放出させる再生操作と、再生終了後に排気流量を回復させてNO_x吸収を再開する操作とを繰り返す内燃機関の排気浄化装置において、

排気流量を回復させて前記NO_x吸収を再開する前の所定期間NO_x吸収剤に還元剤を供給してNO_x吸収剤を通過する排気空燃比を理論空燃比近傍に制御する手段を設けたことを特徴とする内燃機関の排気浄化装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、内燃機関の排気浄化装置に関し、詳細には、ディーゼルエンジンや希薄燃焼を行うガソリンエンジン等、リーン空燃比の燃焼を行う内燃機関の排気中のNO_xを効果的に除去可能な排気浄化装置に関する。

【0002】

【従来の技術】この種の排気浄化装置の例としては、例えば特開昭62－106826号公報に開示されたものがある。同公報の装置は、ディーゼル機関の排気通路に、酸素の存在下でNO_xを吸収する吸収剤（触媒）を配置して排気中のNO_xを吸収させ、該吸収剤のNO_x吸収能力が飽和したときに吸収剤への排気の流入を遮断して吸収剤に還元剤を供給し、NO_x吸収剤をリッチ空燃比下の雰囲気にすることにより吸収剤からNO_xを放出させるとともに放出されたNO_xを還元浄化するようにしたものである。

【0003】

【発明が解決しようとする課題】上記特開昭62－106826号公報の排気浄化装置では、NO_x吸収剤への排気の流入を遮断してNO_x吸収剤に還元剤を供給することにより、NO_x吸収剤の再生操作を行っている（なお、本明細書では上記のNO_x吸収剤からのNO_x放出及び還元浄化の操作を「NO_x吸収剤の再生操作」と呼ぶ）。ところが、上記公報の装置では再生操作終了後、次のNO_x吸収操作再開までの待機期間中NO_x吸収剤を排気の流入を遮断したままの状態に保持すると、高温の排気が供給されないため、待機期間中にNO_x吸収剤の温度が低下してしまう場合がある。特に、排気通路に複数のNO_x吸収剤を並列に接続して、順番に排気の流入を遮断してNO_x吸収剤の再生を行うような場合には、各NO_x吸収剤のNO_x吸収能力を最大限に利用するためにNO_xの吸収を行う時間は再生に必要な時間より大幅に長く設定される。このため、再生操作終了後の待機期間が長くなり、NO_x吸収剤の温度低下も大きくなる。

【0004】NO_x吸収剤のNO_x吸収能力は低温域では大幅に低下してしまうため、上記のように待機期間中にNO_x吸収剤の温度が低下すると、NO_xの吸収を再開した場合にNO_x吸収剤が所定の吸収能力を発揮できず、排気中のNO_xの浄化効率が低下してしまう問題が生じる。これを解決するために、NO_x吸収剤の再生終了後直ちにNO_x吸収操作を開始して待機期間中のNO_x吸収剤の温度低下を防止することも可能であるが、前述のように複数のNO_x吸収剤を並列に排気通路に接続して切り換えて使用するような場合には吸収と再生の切換え周期を短縮すると各NO_x吸収剤のNO_x吸収能力を有効に活用できなくなる問題がある。また、NO_x吸収剤への排気流入遮断に伴う排気抵抗の変動により機関出力に影響が生じる場合があり、切換え周期を短縮することは好ましくない。

【0005】本発明は上記に鑑み、再生操作終了後の待機期間中のNO_x吸収剤の温度低下を防止し、NO_x吸収操作再開時のNO_x吸収剤の吸収能力を高く維持することが可能な内燃機関の排気浄化装置を提供することを目的としている。

【0006】

【課題を解決するための手段】本発明によれば、リーン空燃比の燃焼を行うことのできる内燃機関の排気通路に、流入排気の空燃比がリーンのときに排気中のNO_xを吸収し、流入排気中に還元剤が供給され酸素濃度が低下したときに吸収したNO_xを放出するNO_x吸収剤を配置し、NO_xを吸収させた後にNO_x吸収剤に流入する排気流量を低減するとともにNO_x吸収剤に還元剤を供給して吸収したNO_xを放出させる再生操作と、再生終了後に排気流量を回復させてNO_x吸収を再開する操作とを繰り返す内燃機関の排気浄化装置において、排気流量を回復させて前記NO_x吸収を再開する前の所定期間NO_x吸収剤に還元剤を供給してNO_x吸収剤を通過する排気空燃比を理論空燃比近傍に制御する手段を設けたことを特徴とする内燃機関の排気浄化装置が提供される。

【0007】

【作用】NO_x吸収再開前に、NO_x吸収剤に理論空燃比近傍の空燃比の排気と還元剤との混合気が供給され、NO_x吸収剤上で還元剤の酸化反応熱が生じる。これにより、待機期間中のNO_x吸収剤の温度が高く維持され、NO_x吸収再開時のNO_x吸収剤の吸収能力低下が生じない。

【0008】

【実施例】以下、添付図面を用いて本発明の実施例を説明する。図1において、1はディーゼルエンジン、希薄燃焼を行うガソリンエンジン等のリーン空燃比の燃焼を行うことのできる内燃機関、3は内燃機関1の排気通路

を示す。本実施例では排気通路３には２つの分岐通路３ａ、３ｂが設けられており、通路３ａ、３ｂにはそれぞれ流入する排気空燃比がリーンのときに排気中のNO_xを吸収し、排気中の酸素濃度が低下したときに吸収したNO_xを放出するNO_x吸収剤、それぞれ５ａ、５ｂが接続されている。

【０００９】また、排気通路３の通路３ａ、３ｂの分岐部には排気切り換え弁２が設けられ、排気通路３ａ、３ｂの任意の一方を所定の開度に閉鎖して排気通路３ａ、３ｂに排気を分配するようになっている。例えば排気切換え弁２が図１に実線で示した位置に切り換えられると、排気の大部分は分岐通路３ｂ側に流入し、分岐通路３ａ側に流入する排気流量が低減される。また、排気切換え弁２が図１に点線で示した位置に切り換えられると、排気の大部分は分岐通路３ａ側に流入し、分岐通路３ｂ側に流入する排気流量が低減される。図に２ａで示すのは、後述するエンジン制御回路（ＥＣＵ）２０からの制御信号により切り換え弁２を駆動して所定の切り換え位置をとらせるための負圧アクチュエータ等、適宜な形式のアクチュエータである。

【００１０】また、本実施例では分岐通路３ａ、３ｂはNO_x吸収剤５ａ、５ｂ下流側で再び合流しており、この合流部には排気切換え弁２と同様な排気切換え弁２２と、アクチュエータ２２ａとが設けられている。排気切換え弁２２は、排気切換え弁２と連動して作動し、それぞれの分岐通路に流入する排気流量を制御するとともに、後述のNO_x吸収剤再生操作時に再生中のNO_x吸収剤に下流側から排気が逆流することを防止している。

【００１１】更に、分岐通路３ａ、３ｂのNO_x吸収剤５ａ、５ｂ上流側には後述する還元剤供給装置１１からNO_x吸収剤５ａ、５ｂに還元剤を供給する還元剤供給ノズル、それぞれ１２ａ、１２ｂが接続されている。また、図１に７ａ、７ｂで示すのは、それぞれ分岐通路３ａ、３ｂのNO_x吸収剤５ａ、５ｂ下流側に配置された空燃比センサである。空燃比センサ７ａ、７ｂは排気中の酸素濃度を検出し、広い範囲で排気空燃比に対応した出力電圧を発生する、いわゆる全域空燃比センサが使用される。

【００１２】図に２０で示すのはエンジン１の制御回路（ＥＣＵ）である。ＥＣＵ２０はＣＰＵ、ＲＡＭ、ＲＯＭ、及び入力ポート、出力ポートを相互に双方向バスで接続した構成の公知のディジタルコンピュータからなり、エンジンの燃料噴射量制御等の基本制御を行っている。また、本実施例ではＥＣＵ２０は、更に、図示しない駆動回路や負圧制御弁等を介してアクチュエータ２ａ、２２ａを駆動して排気切り換え弁２、２２の切り換え位置制御を行うほか、還元剤供給装置１１からの還元剤供給制御を行っている。これらの制御のためＥＣＵ２０の入力ポートには、空燃比センサ７ａ、７ｂからの空燃比信号が入力されている他、エンジン回転数、機関吸入空気量等の信号がそれぞれ図示しないセンサから入力されている。

【００１３】還元剤供給装置１１は還元剤容器、加圧ポンプ等から構成される還元剤供給源１３と、還元剤供給源１３から還元剤供給ノズル１２ａ、１２ｂに供給される還元剤供給量の流量を調節する制御弁１４ａ、１４ｂ及び、ノズル１２ａ、１２ｂと制御弁１４ａ、１４ｂとの間に配置された排気逆流防止用の逆止弁１５ａ、１５ｂとを備えている。制御弁１４ａ、１４ｂは、後述するNO_x吸収剤５ａ、５ｂの再生操作時及び、その後の待機期間中に、ＥＣＵ２０の制御信号に応じて所定の開度をとり、開度に応じた量の還元剤をNO_x吸収剤５ａ、５ｂに供給するものである。

【００１４】NO_x吸収剤５ａ、５ｂのNO_x放出、還元操作（再生操作）に使用する還元剤としては、排気中で炭化水素、一酸化炭素等の還元成分を発生するものであれば良く、水素、一酸化炭素等の気体、プロパン、プロピレン、ブタン等の液体又は気体の炭化水素、ガソリン、軽油、灯油等の液体燃料等が使用できる。NO_x吸収剤５ａ、５ｂは例えばアルミナ等の担体を使用し、この担体上に例えばカリウムＫ，ナトリウムＮａ，リチウムＬｉ，セシウムＣｓのようなアルカリ金属、バリウムＢａ，カルシウムＣａのようなアルカリ土類、ランタンＬａ，イットリウムＹのような希土類から選ばれた少なくとも一つと、白金Ｐｔのような貴金属とが担持されている。このNO_x吸収剤５ａ、５ｂは流入する排気の空燃比がリーンの場合にはNO_xを吸収し、酸素濃度が低下するとNO_xを放出するNO_xの吸放出作用を行う。

【００１５】なお、上述の排気空燃比とは、ここではNO_x吸収剤５ａ、５ｂの上流側の排気通路やエンジン燃焼室、吸気通路等にそれぞれ供給された空気量の合計と燃料と還元剤の合計との比を意味するものとする。従って、NO_x吸収剤５ａ、５ｂの上流側排気通路に燃料、還元剤または空気が供給されない場合には排気空燃比はエンジンの運転空燃比（エンジン燃焼室内の燃焼における空燃比）と等しくなる。

【００１６】本実施例では、リーン空燃比の燃焼を行う機関が使用されているため、通常運転時の排気空燃比はリーンであり、NO_x吸収剤５ａ、５ｂは排気中のNO_xの吸収を行う。また、還元剤供給装置１１から排気中に還元剤が導入されて酸素濃度が低下すると、NO_x吸収剤５ａ、５ｂは吸収した還元剤の放出を行う。この吸放出作用の詳細なメカニズムについては明らかでない部分もある。しかし、この吸放出作用は図２に示すようなメカニズムで行われているものと考えられる。次にこのメカニズムについて担体上に白金Ｐｔおよびバリウム Ｂａを担持させた場合を例にとって説明するが他の貴金属、アルカリ金属、アルカリ土類、希土類を用いても同様なメカニズムとなる。

【００１７】すなわち、流入排気がかなりリーンになる

と流入排気中の酸素濃度が大巾に増大し、図2(A)に示されるようにこれら酸素O_2がO_2^-またはO^{2-}の形で白金Ptの表面に付着する。一方、流入排気中のNOは白金Ptの表面上でこのO_2^-またはO^{2-}と反応し、NO_2となる（$2NO+O_2 \rightarrow 2NO_2$）。次いで生成された$NO_2$の一部は白金Pt上で酸化されつつ吸収剤内に吸収されて酸化バリウムBaOと結合しながら、図2(A)に示されるように硝酸イオンNO_3^-の形で吸収剤内に拡散する。このようにしてNO_xがNO_x吸収剤5a、5b内に吸収される。

【0018】従って、流入排気中の酸素濃度が高い限り白金Ptの表面でNO_2が生成され、吸収剤のNO_x吸収能力が飽和しない限りNO_2が吸収剤内に吸収されて硝酸イオンNO_3^-が生成される。これに対して流入排気中の酸素濃度が低下してNO_2の生成量が減少すると反応が逆方向（$NO_3^- \rightarrow NO_2$）に進み、こうして吸収剤内の硝酸イオンNO_3^-がNO_2の形で吸収剤から放出される。すなわち、流入排気中の酸素濃度が低下するとNO_x吸収剤5a、5bからNO_xが放出されることになる。

【0019】一方、流入排気中にHC、CO等の還元成分が存在すると、これらの成分は白金Pt上の酸素O_2^-またはO^{2-}と反応して酸化され、排気中の酸素を消費して排気中の酸素濃度を低下させる。また、排気中の酸素濃度低下によりNO_x吸収剤5a、5bから放出されたNO_2は図2(B)に示すようにHC，COと反応して還元される。このようにして白金Ptの表面上にNO_2が存在しなくなると吸収剤から次から次へとNO_2が放出される。

【0020】すなわち、流入排気中のHC，COは、まず白金Pt上のO_2^-またはO^{2-}とただちに反応して酸化され、次いで白金Pt上のO_2^-またはO^{2-}が消費されてもまだHC，COが残っていればこのHC，COによって吸収剤から放出されたNO_x、および排気とともに流入するNO_xが還元される。本実施例では、排気切換え弁2、22の操作によりNO_x吸収剤5aと5bのNO_x吸収と放出とを交互に行う。すなわち、本実施例では、排気切換え弁2、22の操作により一方のNO_x吸収剤（例えば5a）に大部分の排気を流してNO_xを吸収させる。また、NO_x吸収剤5aのNO_x吸収量が増大してくると、排気切換え弁2、22を切り換えて他方のNO_x吸収剤5bに排気を流し、NO_x吸収剤5aに流入する排気流量を低減するとともに、還元剤供給ノズル12aからNO_x吸収剤5aに還元剤を供給してNO_x吸収剤5aの再生を行う。また、切換え後NO_x吸収剤5bのNO_x吸収量が増大してくると、再度排気切換え弁2、22の切換えを行い、NO_x吸収剤5a側に排気を流してNO_x吸収剤5aによるNO_x吸収を再開するとともにNO_x吸収剤5bの再生を行う。

【0021】上記の、NO_x吸収剤がNO_x吸収を行うことのできる時間は、例えば10分程度と比較的長いのに対して、NO_x吸収剤の再生に必要な時間は、例えば数十秒程度と比較的短い。従って、再生操作が終了したNO_x吸収剤は、次に排気切換え弁が切り換えられてNO_x吸収を再開するまでの間、排気流量を低減したままで待機状態に置かれることになる。このため、待機期間中にNO_x吸収剤の温度が低下してしまう問題が生じる。

【0022】本発明による実施例では、待機中のNO_x吸収剤に還元剤を供給し、NO_x吸収剤を通過する排気の空燃比を理論空燃比近傍に維持することにより、NO_x吸収剤の温度低下の問題を解決している。すなわち、NO_x吸収剤は図2で説明したように、酸素の存在下でHC、CO等の還元成分の酸化を促進する酸化触媒としての機能を有している。従って、待機中のNO_x吸収剤に酸素と還元剤とを供給することにより、NO_x吸収剤上で還元剤の酸化反応を生じさせ、反応熱によりNO_x吸収剤の温度低下を防止することが可能となる。本発明による実施例では、上記酸化反応に最適な理論空燃比近傍に維持した排気と還元剤との混合気を待機中のNO_x吸収剤に供給することにより、NO_x吸収剤の温度を高く保持してNO_x吸収再開時の吸収能力の低下を防止している。

【0023】次に、本実施例の排気浄化操作について説明する。以下の説明では、図1のNO_x吸収剤5aのNO_x吸収及び再生操作について説明するが、NO_x吸収剤5bについても全く同様に吸収、再生操作が行われる。排気切換え弁2、22が図1の点線の位置に保持され、NO_x吸収剤5aに機関の排気の大部分が流入すると、NO_x吸収剤5aは前述のように排気中のNO_xの吸収を行う。次いで、所定時間が経過してNO_x吸収剤5aのNO_x吸収量が増大するとECU20は、排気切換え弁2、22を図1の実線の位置に切り換え、NO_x吸収剤5aの再生操作を開始する。

【0024】なお、本実施例ではNO_x吸収剤の再生は一定時間毎に行われるが、機関のNO_x発生量に応じてNO_x吸収剤のNO_x吸収量が所定値に達する毎にNO_x吸収剤の再生を行うようにしてもよい。この場合、ECU20は、機関の単位時間当たりのNO_x発生量を機関負荷（例えば、機関1回転当たりの吸入空気量）と機関回転数との関数としてROMに予め格納しておき、所定時間毎に機関負荷条件を読みとり、ROMから上記のNO_x発生量を読みだし、この発生量に一定の係数を乗じたものを積算してNO_x吸収剤のNO_x吸収量とする。このNO_x吸収量が所定値に達したときにNO_x吸収剤の再生を行うようにすれば、機関NO_x発生量の変化にかかわらず、NO_x吸収剤のNO_x吸収能力を有効に活用することができる。

【0025】排気切換え弁2、22が図1の実線の位置に切り換えられると、NO_x吸収剤5aに流入する排気

流量が低下し、排気の大部分はNOx吸収剤5bを通過して流れるため、NOx吸収剤5bによる排気中のNOx吸収が行われる。NOx吸収剤5aの再生操作は、以下の手順で行われる。まず、ECU20は、NOxの吸収を開始したNOx吸収剤5bの下流側に配置された空燃比センサ7bの出力から機関の排気空燃比を読みとり、この排気空燃比と、再生を行うNOx吸収剤5a側に流入する排気流量とからNOx吸収剤5aに供給すべき還元剤流量を決定する。本実施例では、再生操作時にNOx吸収剤に供給する還元剤流量は、NOx吸収剤に流入する排気空燃比を理論空燃比より所定量だけリッチ側に維持する量とされる。また、再生操作時に排気切換え弁を通過してNOx吸収剤に流入する排気流量は、機関負荷、回転数等の運転条件の関数として、予め実測などにより求めておき、ROMに格納しておく。

【0026】ECU20は、還元剤供給装置11の制御弁14を、上記により算出された還元剤流量に対応する開度に設定してNOx吸収剤5aに還元剤の供給を行うとともに、NOx吸収剤5a下流側の空燃比センサ7aの出力に基づいて還元剤の供給時間を制御する。前述のように、NOx吸収剤への還元剤供給が開始されると、まず還元剤は排気中やNOx吸収剤のPt表面のO_2を消費し、このO_2を消費した後にNOxの還元浄化を開始する。従って、還元剤供給開始後初期の段階では、NOx吸収剤から流出する排気中の酸素濃度は比較的高くなっており、上記O_2が消費され、NOxの還元が始まると排気中の酸素濃度が急激に低下する。ECU20は、空燃比センサ7aの出力変化から上記酸素濃度の低下を検出した後所定期間の間、排気空燃比がリッチになるように前記還元剤供給量を維持する。これによりNOx吸収剤再生終了後に過剰な還元剤がNOx吸収剤から流出することが防止される。なお、この期間は、NOx吸収剤に吸収したNOx量（吸収時間）に応じて予め設定されている。

【0027】上記再生操作終了後、NOx吸収剤5aは排気の流量を低減したまま次回のNOx吸収開始に備えて待機状態に置かれる。本実施例ではECU20は、上記再生時間が経過した後、待機中のNOx吸収剤5a下流側の排気空燃比が理論空燃比近傍になるように、空燃比センサ7aの出力に基づいて制御弁14aの開度をフィードバック制御する。このように、下流側の空燃比センサ出力に基づいて還元剤供給量をフィードバック制御することにより、待機中のNOx吸収剤を通過する排気空燃比は正確に理論空燃比近傍に保持されるため、NOx吸収剤に供給された還元剤の良好な酸化反応が得られ、待機中のNOx吸収剤温度を高く維持することができる。また、これによりNOx吸収剤に供給された還元剤の全量を酸化することができるため、過剰な還元剤がNOx吸収剤下流に流出することが防止される。

【0028】図3は、上記操作による、NOx吸収剤に流入する排気空燃比の変化サイクルを示している。図3において、NOx吸収剤のNOx吸収操作時にはNOx吸収剤に流入する排気空燃比はリーン空燃比に維持される（図3、区間 I）。次いで排気切換え弁の切換えが行われると、NOx吸収剤に還元剤が供給され、切換え後の所定期間排気空燃比はリッチ空燃比に保持され、NOx吸収剤の再生が行われる（図3、区間II）。また、NOx吸収剤の再生が終了したあとの待機期間中は、排気空燃比は理論空燃比近傍に維持され、NOx吸収剤の温度が高く維持される（図3、区間 III）。この状態で再度排気切換え弁の切換えが行われるとNOx吸収剤に流入する排気の空燃比は再びリーン空燃比になり、NOx吸収剤は温度が低下することなくNOx吸収を再開する（図3、区間 IV）。

【0029】なお、上述の実施例ではNOx吸収剤の再生操作が終了後、引き続きNOx吸収剤に流入する排気空燃比を理論空燃比に維持しているが、待機期間が特に長い場合には、再生操作終了後一旦還元剤の供給を停止し、NOx吸収を再開する前の所定の期間だけ還元剤を供給して排気空燃比を理論空燃比に維持することにより、NOx吸収再開前にNOx吸収剤温度を上昇させるようにしてもよい。

【0030】また、本実施例では、還元剤の供給量の制御のみによって待機中のNOx吸収剤に流入する排気空燃比を調節しているが、還元剤供給量とともに排気切換え弁2、22の開度を制御して流入する排気量を調節することにより排気空燃比を制御することも可能である。

【0031】

【発明の効果】本発明の排気浄化装置は、上述のようにNOx吸収再開前の待機中のNOx吸収剤に理論空燃比近傍の排気と還元剤との混合気を供給するようにしたことにより、待機中のNOx吸収剤の温度低下を有効に防止し、NOx吸収開始時のNOx吸収剤の吸収能力を高く維持することが可能となる効果を奏する。

【図面の簡単な説明】

【図1】本発明の排気浄化装置の一実施例を示す全体図である。

【図2】NOx吸収剤のNOxの吸放出作用を説明する図である。

【図3】NOx吸収剤に流入する排気空燃比の変化サイクルを説明する図である。

【符号の説明】

1…内燃機関

3…排気通路

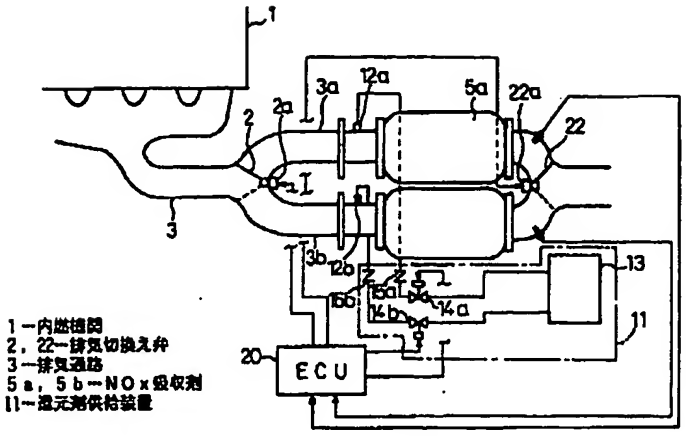
3a、3b…分岐通路

5a、5b…NOx吸収剤

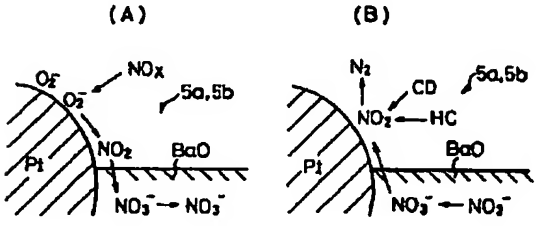
2、22…排気切り換え弁

11…還元剤供給装置（全体）

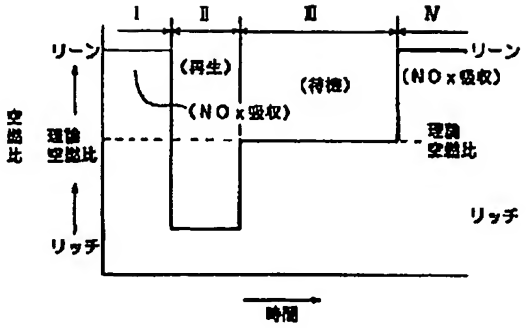
【図1】



【図2】



【図3】



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(72)発明者 小端 喜代志
愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内